the flexible printed circuit board. See the substitute specification at page 4, lines 22-30. Fig. 2 shows an example of a fatigue test of the flexible printed circuit board 10 of the present invention.

The example of Applicants' flexible printed circuit board invention described above has the same basic structure as a conventional flexible printed circuit board shown in Fig. 1. Although Applicants' flexible printed circuit board has the same basic structure of the conventional flexible printed circuit board as shown in Fig. 1, Applicants' flexible printed circuit board is distinguished from the conventional flexible printed circuit board by the claimed glass transition temperature. Accordingly, Applicants respectfully submit that an example of all of the features of the present invention specified in the claims are shown in the drawings. Thus, Applicants respectfully submit that the objection to the drawings is improper and should be withdrawn.

Although Applicants believe no amendments to the drawings are required, Applicants provisionally submit a proposed new Fig. 3 in the event that the drawing objection is maintained. Fig. 3 is the same as Fig. 1 accept for reference numerals. Accordingly, Fig. 3 does not include any new matter. If the Examiner requires entry of Fig. 3, Applicants will submit a further amendment to the specification to refer to Fig. 3 and the corresponding reference numerals.

§103 REJECTION OF CLAIMS 1-6

In Office Action paragraph 3, claims 1-6 were rejected under 35 U.S.C. §103(a) as being unpatentable over Gurrie et al. , U.S. Patent No. 5,296,651 in view of Noda et al., U.S. Patent No. 4,913,955. Applicants respectfully disagree.

The present invention provides, as claimed in claim 1, a flexible printed circuit board comprising a base film, a base film side adhesive layer provided on the base film, a metal foil layer on which a pattern circuit is formed, provided on the base film side adhesive layer, and a cover layer side adhesive layer provided on the metal foil layer. Claim 1 further calls for at least one of the base film side adhesive layer and the cover layer side adhesive layer to have a higher glass transition temperature than the operating temperature of the flexible printed circuit board.

One object of the present invention is to provide a stable flexible printed circuit board (FPC) having excellent flexural fatigue endurance (bending life) even if the FPC is used in equipment such as a hard disk drive (HDD) in which the operating (environmental) temperature

is anticipated to vary from room temperature up to about 80°C. For example, when the FPC is used in equipment such as an HDD, the FPC is flexibly bent according to movement of a movable part, such as a read/write head, and the reciprocation number N indicating the bending life of the FPC (the flexural fatigue endurance) is from 1 x 10^6 times (cycles) to 1 x 10^7 times (cycles) or even up 1 x 10^9 times (cycles). Applicants' FPC with the claimed glass transition temperature can provide superior and remarkable flexural fatigue endurance (bending life) indicated by a remarkably large reciprocation number N or cycle life.

Turning to Gurrie et al., Gurrie et al. pertains to a flexible circuit with a ground plane and has an objective which is significantly different from Applicants' invention. Gurrie et al. seeks to eliminate cross-talk between conductor traces in close proximity without reducing flexibility of the flexible circuit. Accordingly, Gurrie et al. is mainly concerned with eliminating cross-talk while maintaining flexibility rather than significantly increasing flexibility to the high flexibility levels achieved by Applicants' invention. For this reason alone, Applicants respectfully submit that there is no teaching, motivation, or suggestion to combine Gurrie et al. with another reference to modify an adhesive to have the glass transition temperature as claimed in claim 1.

Furthermore, Applicants submit that there is not teaching, motivation, or suggestion to modify the adhesive in Gurrie et al. to have the claimed glass transition temperature because Gurrie et al. teaches the use of a ground plane (sputtered copper film) to achieve the objective of reducing cross-talk. Referring to Fig. 2a of Gurrie et al., the flexible circuit has a plurality of conductor traces 12 positioned along a neutral access 14. A thin film metallic planer conductor (ground plane) 18 of sputtered copper film is formed on at least one of dielectric substrates 16, 24. Adhesive layers 20 and 22 bond the conductor traces 12 between the dielectric substrates 16, 24. Gurrie et al. teaches the use of the ground plane 18 to reduce or eliminate cross-talk between the conductor traces 12. Because the copper film ground plane is provided at an inner surface of the dielectric layer in Gurrie et al., the flexible circuit will not have the remarkable high bending life (cycle life) as Applicants' invention. For example, Applicants' flexible circuit board can achieve a reciprocation number N indicating the bending life of 1 x 10^6 times (cycles) to 1 x 10^7 times (cycles) or even up to 1 x 10^9 times (cycles). Applicants submit that the Gurrie et al. copper film ground plane will not withstand such a high cycle life.

Accordingly, there is no teaching, motivation, or suggestion to modify the Gurrie et al. adhesive layers to have the claimed glass transition temperature in order to increase the cycle life

because the Gurrie et al. copper film ground layer would not be able to achieve such a high cycle life.

Turning to Noda et al., Noda et al. pertains to an epoxy resin laminate and purports to overcome a problem of flexible circuit boards having insufficient size stability, i.e., too flexible. An object of Noda et al. is to provide a bendable laminate having an improved size stability and low flexion, particularly at high temperatures during soft soldering. The objective of Noda et al. to reduce flexion at high temperatures is completely different from an object of Applicants' invention which is to increase cycle life flexibility at high temperatures.

The Noda et al. objective of high temperature reduced flexion is also completely different from the Gurrie et al. objective of reducing cross-talk by use of a ground plane. Accordingly, Applicants respectfully submit that there is no teaching, motivation, or suggestion to combine Noda et al. with Gurrie et al. to achieve Applicants' claimed invention.

Referring to Fig. 1 of Noda et al., the bendable laminate adapted to have a low flexion includes a center layer of glass fiber woven cloth 5. The glass fiber woven cloth 5 is permeated with epoxy resin to harden the circuit laminate and to prevent the laminate from having high flexion while holding a bent characteristic when subject to high temperature treatment. In other words, the glass fiber woven cloth and resin reduce the flexion of the Noda et al. laminate in accordance with the objective of Noda et al. The Noda et al. laminate has low flexion rather than a remarkably high flexible cycle life.

Furthermore, Noda et al. describes its bending characteristic as winding the laminate around a cylindrical rod 7 and measuring a radius R (mm) of the bent condition of the laminate after the bending stress was relieved. See Noda et al., column 4, lines 41-47. The Noda et al. bending characteristic in which Noda et al. desires to maintain the bent characteristic shape by reducing flexion is completely different from Applicants' remarkably increased cycle life of the flexible printed circuit board. Nowhere does Noda et al. disclose or suggest that its low flexion laminate which has glass fiber woven cloth and epoxy resin provide a high flexural fatigue endurance or cycle life. Indeed, Noda et al. teaches using a glass fiber woven cloth and epoxy resin to reduce flexion at high temperatures. Accordingly, Noda et al. does not provide a teaching, motivation, or suggestion to use an adhesive having a glass transition temperature as claimed by Applicants to increase the cycle flex life of the circuit board. Applicants submit that the Noda et al. reduced flexion laminate would not be able to withstand a similar bending life

cycle as Applicants' invention, such as a reciprocation number N indicating the being life of 1 x 10^6 times (cycles) to 1 x 10^7 times (cycles) or even up to 1 x 10^9 times (cycles).

Thus, Applicants respectfully submit that there is no teaching, motivation, or suggestion to combine Gurrie et al. with Noda et al. and the §103(a) rejection should be withdrawn.

Even if Gurrie et al. and Noda et al. are combined, the combination does not result in Applicants' claimed invention. Neither Gurrie et al. or Noda et al. provide the claimed feature of at least one of the base film side adhesive layer and the cover layer side adhesive layer having a higher glass transition temperature than an operating temperature of the flexible printed circuit board. Therefore, the combination of Gurrie et al. and Noda et al. does not result in Applicants' claimed invention.

Even if Gurrie et al. and Noda et al. are combined, the combination would result in a circuit board having a ground plane to reduce cross-talk (Gurrie et al.) and a low flexion laminate having glass fiber woven cloth permeated with epoxy resin (Noda et al.). Such a combination does not result in a flexible printed circuit board having at least one of a base film side adhesive layer and a cover layer side adhesive layer having a higher glass transition temperature and an operating temperature of the flexible printed circuit board. Further, the combination does not result in a flexible printed circuit board having the remarkably high bending life of Applicants' invention, in particular, a bending life of from 1 x 10^6 times (cycles) to 1 x 10^7 times (cycles) or even up to 1 x 10^9 times (cycles).

Thus, Applicants respectfully submit that the §103(a) rejection of claims 1-6 has been overcome.

REQUEST FOR NON-FINAL ACTION

The Office Action mailed May 10, 2002 is a final Office Action. Applicants respectfully submit that the Office Action should not have been made final. In the event that this response does not place the case in condition for allowance, Applicants request that the May 10, 2002 Office Action be changed to a non-final Office Action.

A second action on the merits should not be made final when the Examiner introduces a new ground of rejection that is neither necessitated by Applicants' amendment of the claims nor based on information submitted in an Information Disclosure Statement. M.P.E.P. §706.07(a). The May 10 Office Action introduced a new ground of rejection, the only current rejection,

which was not necessitated by Applicants' amendment submitted March 19, 2002. Applicants' March 19 amendment to claims 1, 5, and 6 merely clarified the claims by making very minor amendments. No substantive limitations were added to the claims. As to claim 1, the term "an operating" was substituted for "the working environment." As to claims 5 and 6, the claimed bending life was clarified as a "reciprocation number N indicating a bending life," "per minute" was deleted, and "million times" was substituted for "millions" in claim 6. These amendments did not necessitate a new ground of rejection.

The May 10 Office Action entered a new ground of rejection under §103 based on newly cited references, Gurrie et al. (5,296,651) and Noda et al. (4,913,955). The §103 rejection based on Gurrie et al. and Noda et al. should have been made in the first Office Action dated December 28, 2001 or the May 10 Office Action should not have been made final. Applicants' amendment to claims 1, 5, and 6 submitted March 19, 2002 did not necessitate a further search and new ground of rejection. Thus, the May 10, 2002 Office Action should not have been made final. Applicants request that if this response does not place the case in condition for allowance, the May 10 Office Action should be made a non-final Office Action.

Respectfully submitted,

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